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BERTRAM P. BROWN, M.D., Director

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GUY P. JONES  
EDITOR

## *Industrial Hygiene and the National Defense Program\**

By J. P. RUSSELL, M.D., Chief, Industrial Hygiene Service, California State Department of Public Health

Because of its numerous and diversified industries, and its wealth of essential raw materials, California is one of the key states in the national preparedness program. Normally it ranks eighth among all states in the country in its industrial population. At the present time, nearly a million persons are employed in California industries which are vital to national defense, and this number is increasing rapidly. Outstanding among these industries are our aircraft factories, ship building yards, petroleum production fields and refineries, machine tool and die factories, foundries, automobile and tractor plants, explosives factories, quicksilver, chromium, lead, tungsten and manganese mines, rubber factories, electroplating plants, lumber mills, and tin plate factories. Thousands of workers in these industries are exposed, in the course of their employment, to harmful gases, dusts, vapors and chemicals, and to environmental conditions such as excessive heat, dampness, noise and defective illumination, which have a detrimental effect on health unless they are adequately controlled.

A recent official tabulation showed that about ten thousand industrial plants in the United States have already been awarded government contracts to manufacture vital defense materials for our armed services. California, with more than six hundred plants employed on such contracts, is sixth in the order of

importance in this list, being exceeded only by Pennsylvania, New York, Ohio, Illinois and Massachusetts.

It has been aptly said that "health is the backbone of production and production is the keystone of defense." Therefore, the health conservation of workers, which is the basic objective of industrial hygiene, is of utmost importance to the success of the defense program.

Effective work in industrial hygiene requires the closely coordinated efforts of the physician, the engineer and the chemist. The physician is responsible for the diagnosis of occupational diseases and for the recognition of underlying faulty conditions in the working environment. It is then the engineer's function to determine where and what control measures are needed to correct these conditions. No one, regardless of his academic training or practical experience, can tell by a casual inspection of a plant whether harmful materials are present in such quantities as to jeopardize the health of workers or whether the exposed employees are provided with sufficient protection against these hazards. In order to establish these facts it is necessary for the engineer and the chemist to make accurate field and laboratory studies of the nature, quantity and distribution of potentially harmful materials and atmospheric contaminants in the workroom. When these findings are correlated with a knowledge of the toxicity of the

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materials involved and with the physician's records of the physical condition of workers, showing the actual effects of these materials on the human body, the degree of the hazard and the need for control measures may be determined accurately, without recourse to guesswork.

Industrial hygienists are much better prepared today to cope with occupational diseases than they were during the first world war. In the past twenty years many new instruments of precision and laboratory methods have been developed for the accurate measurement and evaluation of occupational health hazards. As a result of extensive research work and clinical and laboratory studies, the toxic threshold or maximum safe concentration of many of the potentially harmful materials encountered in industry has now been definitely established. For example, we now know that the maximum quantity of free silica dust which may be breathed over a prolonged period of time without danger to health, is five million particles of the dust smaller than five microns in diameter, per cubic foot of air breathed. The toxic threshold of chromic acid vapor has been found to be one milligram in ten cubic meters of air breathed. We now know that the maximum quantity of mercury which can be absorbed into the human body daily without danger of cumulative poisoning is between one and two milligrams. The safe limit of carbon monoxide, benzol, and carbon tetrachloride for long exposures has been found to be one hundred parts in one million parts of air breathed, or 0.01 per cent; and so on down the list of harmful dusts, gases, vapors, fumes, and chemicals.

Harmful industrial materials may exert their injurious effects on the human body either locally, or through general systemic poisoning, or both. The local effects include such conditions as skin irritations, eye injuries and burns. Of these, the skin effects or dermatoses are by far the most frequent in occurrence. About two-thirds of all reported occupational disease cases in California fall within this group. Systemic effects may result from the absorption of poisonous materials directly through the skin, as in the case of tetraethyl lead; by inhalation of gases, vapors, and fumes into the lungs, where they are absorbed directly into the blood stream; or by the entrance of poisons into the body through the digestive tract from contaminated food or other objects which are placed in the mouth.

No arbitrary, all-inclusive rules can be prescribed for the control of industrial health hazards. Each plant, and each workroom in the plant, presents a problem which requires detailed individual study.

However, certain basic practices are commonly utilized in the prevention of occupational diseases. These include the substitution, wherever possible, of a harmless or relatively harmless material for the dangerous one, such as the use of steel shot in place of sand for the abrasive cleaning of castings; the isolation or mechanical enclosure of dangerous processes, such as the use of spray-painting booths, welding booths and sand-blasting cabinets; wet methods of handling materials which generate injurious dusts, such as wet rock drilling in mines and tunnels; local exhaust ventilation to trap the harmful dust or gas at its source and thus prevent it from reaching the workers' breathing level; the use of personal protective devices, such as positive-pressure air helmets, respirators, gas masks, goggles, and protective clothing; careful personal hygiene, including frequent washing, bathing, and change of work clothing; reduction of length of exposure by rotating workers in hazardous jobs, or by shortening working hours; and selection of the least susceptible individuals for occupations in which workers are exposed to materials, such as skin irritants, which affect some persons more than others.

Industrial hygiene is concerned not only with the prevention of specific occupational diseases, but also with many closely related problems, such as industrial heating, ventilating, air-conditioning, illumination, sanitation, hours of labor, fatigue, women and children in industry, noise, overcrowding, mental and personal hygiene, and medical and nursing services in industry. In other words, it embraces the entire field of adult health conservation.

Industrial health problems, always important in the national economy, have become even more important in the present emergency, due to the acute shortage of skilled labor. Every effort must be made to maintain the health and productive efficiency of industrial workers at a high level. When an industrial operation involves exposure to disease-producing agents or conditions, the effect on production is more serious than the number of completely disabled workers in this occupation would indicate. As the health of employees is impaired, often by imperceptible degrees, their working ability is decreased long before they are totally incapacitated. When they become disabled, or seek other employment because they realize that the work is affecting their health, new workers must be found to replace them. In the case of skilled labor, this requires a lengthy and expensive training period, with a consequent slowing-up of production.

The conversion of peace-time industries to the production of defense materials introduces new and serious health hazards in the form of new processes and the use of unfamiliar chemicals, the toxic properties of which are in many instances unknown as yet. The ordinary hazards of employment are intensified by the overexposure of workers due to increased plant output, overtime work, and fatigue. For example, persons exposed to atmospheric concentrations of lead dust and fumes which are not dangerous under normal conditions, have been found to develop cumulative lead poisoning when they work long hours at top speed. The human body is capable of throwing off certain amounts of toxic materials during the hours spent away from work. When exposure is increased beyond this safe limit, acute or chronic poisoning inevitably follows.

With the acceleration of industrial tempo plant officials naturally tend to devote their attention chiefly to the maintenance and uninterrupted operation of machinery, rather than to the control of harmful dusts, fumes and chemicals which are involved in its operation. This calls for an increased vigilance by the industrial hygienist in supervising protective measures such as ventilating systems and the use of personal protective equipment. For example, when a new worker finds that he experiences no immediate discomfort if he forgets to wear his respirator and breathes air laden with silica dust he is apt to remove the respirator whenever he is not observed by his foreman, since it is inconvenient and slightly uncomfortable to wear. Therefore, in training new workers, the potential health hazards of their jobs, and the necessity for the use of proper protective devices, must be fully explained to them, and must be followed up by strict enforcement.

The speeding-up of industrial production to fulfill the needs of urgent defense preparations brings with it a tendency to lengthen working shifts, with resulting excessive physical and mental fatigue. It must be borne in mind that maximum efficiency of production is achieved, not by taxing human endurance to the limit, but by conserving the health and strength of workers. Lengthening of normal working periods does not result in a proportional increase in output, except for short periods. On the contrary, it causes production to fall off with increasing rapidity, as was shown conclusively during the war of 1914-18. Since endurance, and not speed, is the deciding factor in any prolonged effort, overtime work should be limited and workers should be required to take occasional periods of rest.

Physical examinations constitute one of the most important features of an industrial health program. Applicants for jobs should be given complete examinations prior to employment, not for the purpose of excluding them from work but as a guide to their intelligent placement in the type of work for which they are best fitted physically, and in order to prevent those who are suffering from communicable diseases, such as active tuberculosis or syphilis in a contagious state, from infecting fellow workers. All employees should be given periodic examinations at frequent intervals, in order to detect physical defects and diseases in their early stages, when proper treatment will prevent much needless suffering and loss of time and money later on. With the induction into military service of many of the able-bodied men now employed in industry and their replacement by older men and by those who are less qualified physically for strenuous work, the importance of pre-employment and periodic physical examinations and industrial medical and nursing services will be multiplied manifold.

In order to provide an effective health conservation service for California's industrial workers, a program of expanded industrial hygiene activities has been developed by the State Department of Health to conform with the policies of the U. S. Public Health Service. This plan does not contemplate any new or spectacular approach to the problem. However, through it we hope to make available to all workers in defense industries the tried and proven methods of health protection which have been the basis of the California industrial hygiene program for the past three years. These activities include:

1. The investigation and control of specific industrial hazards which are capable of causing occupational diseases, such as dusts, fumes, gases, vapors, defective illumination, excessive temperatures and humidities.
2. Advice to industries on the location and construction of new plants, and on the renovation of old plants, in the interests of safety and health. It is much simpler and cheaper to build safety devices and proper ventilation and illumination into a new factory than to graft them on after the plant is built.
3. The promotion of physical examinations and medical and nursing services in industries.
4. The dissemination of information on toxic industrial materials and products, and on practical methods for their control.
5. The promotion of measures for the control of syphilis, tuberculosis, and other communicable diseases among industrial workers.

## MORBIDITY

Complete Reports for Following Diseases for Week Ending  
October 5, 1940

## Chickenpox

73 cases: Berkeley 1, Oakland 7, San Leandro 1, Butte County 1, Los Angeles County 6, Alhambra 1, Glendale 1, Los Angeles 8, Pasadena 2, Pomona 1, Santa Monica 1, Hawthorne 1, Maywood 1, Madera County 3, Yosemite National Park 1, Monterey County 1, Orange 1, Riverside 2, San Bernardino County 2, San Diego 3, San Francisco 5, Stockton 3, San Mateo 2, Santa Maria 2, Palo Alto 2, San Jose 1, Shasta County 2, Sonoma County 4, Stanislaus County 5, Tulare County 1, Ventura County 1.

## Diphtheria

14 cases: San Leandro 1, Chico 1, Kern County 2, Los Angeles 2, Santa Monica 1, Orange County 1, Ontario 1, San Bernardino 1, San Luis Obispo County 2, Yreka 1, Ventura 1.

## German Measles

12 cases: Alameda 1, Berkeley 1, Oakland 1, Long Beach 1, Los Angeles 2, Santa Monica 1, Lynwood 1, Monterey County 1, San Diego 2, Santa Clara County 1.

## Influenza

21 cases: Los Angeles County 3, Los Angeles 7, Mendocino County 1, Riverside County 1, Sacramento County 1, Sacramento 1, San Francisco 1, Corning 5, Santa Paula 1.

## Malaria

7 cases: Fresno County 1, Fresno 1, Marin County 1, Dos Palos 1, San Joaquin County 1, Tehama County 1, California 1.\*

## Measles

36 cases: Albany 1, Oakland 1, San Leandro 1, Placerville 1, Fresno County 1, Sanger 5, Kern County 1, Los Angeles County 2, El Monte 1, Los Angeles 5, San Anselmo 1, Pacific Grove 1, Soledad 1, Napa 1, Riverside 1, Sacramento 1, San Diego 1, San Francisco 2, Santa Barbara County 3, Santa Barbara 1, Petaluma 1, Modesto 1, Tulare County 1, Lindsay 1.

## Mumps

141 cases: Alameda 2, Oakland 6, San Leandro 1, Fresno County 13, Sanger 3, Kern County 1, Bakersfield 3, Delano 1, Los Angeles County 16, Alhambra 1, Burbank 1, Compton 1, El Segundo 2, Glendale 1, Huntington Park 1, La Verne 1, Long Beach 5, Los Angeles 10, Pasadena 1, Redondo 1, Whittier 8, Torrance 1, Lynwood 1, Hawthorne 1, San Anselmo 1, Yosemite National Park 1, Mendocino County 1, Orange County 4, Fullerton 1, Huntington Beach 1, Newport Beach 1, Orange 3, Santa Ana 2, Seal Beach 1, La Habra 1, Corona 2, San Diego 2, San Francisco 6, San Joaquin County 1, Paso Robles 2, San Luis Obispo 1, Santa Barbara County 1, Santa Maria 3, Palo Alto 3, San Jose 3, Santa Cruz County 1, Stanislaus County 1, Exeter 1, Ventura County 10, Ventura 5.

## Pneumonia (Lobar)

29 cases: Oakland 2, Coalinga 1, Kern County 2, Los Angeles County 3, Alhambra 1, El Monte 1, Inglewood 1, Los Angeles 2, Monrovia 1, Santa Monica 1, Hawthorne 1, Gardena 1, Mendocino County 1, Napa County 1, Orange County 1, Sacramento County 1, Sacramento 2, San Mateo County 1, Redwood City 1, Santa Barbara 1, Santa Clara County 1, Palo Alto 1, Ventura County 1.

## Scarlet Fever

99 cases: Alameda County 1, Albany 1, Oakland 1, Pittsburg 1, Fresno County 2, Humboldt County 1, Kern County 9, Los Angeles County 12, Burbank 1, Compton 1, Glendale 1, Huntington Park 2, La Verne 1, Long Beach 1, Los Angeles 9, Manhattan 2, Pomona 1, San Gabriel 1, Maywood 1, Orange County 2, Anaheim 1, Corona 1, Sacramento 6, San Bernardino County 1, Redlands 1, San Diego County 1, San Diego 4, San Francisco 5, San Joaquin County 10, Stockton 2, San Luis Obispo County 2, Santa Barbara 2, Santa Cruz County 1, Vallejo 1, Sonoma County 5, Stanislaus County 2, Sutter County 1, Tehama County 1, Ventura County 1.

## Smallpox

No cases reported.

## Typhoid Fever

5 cases: Fresno County 1, Los Angeles County 1, Merced County 1, Sacramento 1, National City 1.

## Whooping Cough

262 cases: Berkeley 14, Oakland 12, Butte County 2, El Cerrito 1, Pittsburg 2, Fresno County 3, Kern County 1, Los Angeles County 39, Burbank 1, Claremont 2, Compton 3, Culver City 1, Huntington Park 3, Long Beach 12, Los Angeles 24, Pasadena 10, Pomona 7, San Fernando 3, San Gabriel 3, Santa Monica 2, Hawthorne 1, Monterey Park 2, Maywood 3, Madera County 4, San Anselmo 1, Monterey County 5, Monterey 2, Fullerton 1, Santa Ana 1, Placentia 3, Riverside County 1,

San Bernardino 1, San Diego County 2, Chula Vista 2, San Diego 1, San Francisco 24, San Joaquin County 4, Stockton 6, San Luis Obispo County 8, San Luis Obispo 3, San Carlos 2, Santa Barbara County 4, Santa Barbara 1, Santa Maria 1, Palo Alto 2, San Jose 2, Santa Cruz County 1, Sonoma County 3, Petaluma 2, Santa Rosa 1, Stanislaus County 4, Modesto 3, Tehama County 2, Ventura County 7, Santa Paula 2.

## Meningitis (Epidemic)

One case: Palo Alto.

## Dysentery (Amoebic)

7 cases: Los Angeles County 1, Montebello 1, Chino 1, San Bernardino 1, San Diego County 1, Stockton 1, Shasta County 1.

## Dysentery (Bacillary)

9 cases: Los Angeles County 2, Long Beach 1, Los Angeles 3, Pasadena 1, Sonoma County 1, Oxnard 1.

## Ophthalmia Neonatorum

3 cases: Pittsburg 1, Los Angeles County 1, Los Angeles 1.

## Poliomyelitis

10 cases: Los Angeles County 1, Burbank 1, El Monte 1, Los Angeles 2, San Francisco 1, San Joaquin County 1, San Bruno 1, Modesto 1, Tuolumne County 1.

## Tetanus

One case: Santa Clara County.

## Trachoma

One case: Redondo.

## Encephalitis (Epidemic)

6 cases: Fresno County 2, Sacramento County 1, San Mateo County 1, Modesto 1, Ventura County 1.

## Paratyphoid Fever

2 cases: Glendora 1, San Diego County 1.

## Trichinosis

One case: San Leandro.

## Food Poisoning

5 cases: Oakland.

## Undulant Fever

6 cases: Covina 1, Monrovia 1, Redondo 1, Santa Ana 1, Sonoma County 1, California 1.\*

## Coccidioides Granuloma

One case: Watsonville.

## Epilepsy

30 cases: Oakland 2, Fresno 1, Los Angeles County 3, Inglewood 1, Los Angeles 17, Whittier 1, Sacramento 3, San Francisco 1, Sonoma County 1.

## Rabies (Animal)

7 cases: Los Angeles County 2, Los Angeles 3, Torrance 1, Palos Verdes Estate City 1.

\* Cases charged to "California" represent patients ill before entering the state or those who contracted their illness traveling about the state throughout the incubation period of the disease. These cases are not chargeable to any one locality.

Man's intellectual and spiritual destiny is in no small degree determined by what and how he reads. As reading is a mark of civilized peoples, so is it of individuals who grow and progress. Its importance, which arose with the art of writing, mounted rapidly after the invention of printing, and reached its present climax through the wide diffusion of books.—Leon J. Richardson.

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San Francisco, Calif.